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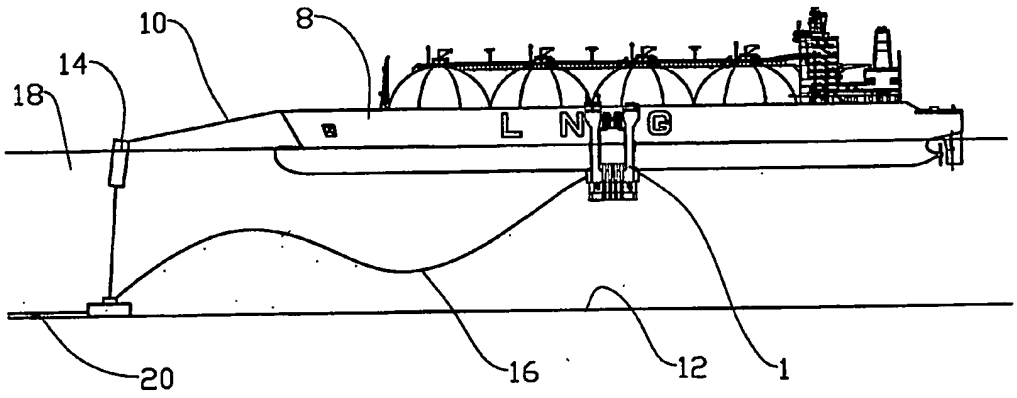
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A CARGO EVAPORATION DEVICE FOR USE WHEN UNLOADING SHIPS



(57) Abstract: A coupling unit device for unloading of a ship, where the coupling unit comprises a hull and is arranged to be connected to the ship by means of a connecting element wherein the coupling unit is provided with an evaporator for liquefied natural gas (LNG) and the required pipe elements for transporting liquefied natural gas from the ship to the evaporator, as well as the required pipe elements for transporting the evaporated gas from the evaporator to a pipe for onward transport. The coupling unit is free-floating and is arranged to manoeuver itself to the ship during the connection and disconnection from the ship by means of its own propulsion machinery.

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A CARGO EVAPORATION DEVICE FOR USE WHEN UNLOADING SHIPS

This invention regards a cargo evaporation device for use when unloading ships. More particularly, it concerns a floating coupling unit arranged to connect to a ship, preferably at the ship's loading manifold, and which is provided with a submerged cargo evaporation device. The coupling unit is connected to a gas receiving installation via a pipeline.

It is well known that liquefied natural gas (LNG) is transported in a chilled state across great distances in purpose-built ships. At the receiving site, the liquefied gas is normally pumped from the ship and into storage tanks of a considerable size, whereupon the gas is evaporated prior to flowing into a distribution network.

Evaporation of natural gas from the highly chilled, liquid form into a gaseous form requires a significant addition of heat to the gas.

Thus, receiving installations for liquefied natural gas are relatively large, as the same time as the costs of building and operating such installations are significant.

In areas where no such receiving installations are provided, the gas cargo on the ship can not be unloaded immediately but at the rate of consumption of the gas.

It is known to use the carrier as a storage facility for the gas while it is being pumped into the gas receiving installation. Thus US patent 6 089 022 concerns a ship for transport of liquefied natural gas, provided with gas evaporators. The evaporators are heated by seawater. The ship is designed to deliver evaporated natural gas to an onshore installation as the gas is used.

Consequently, in the case of installations according to prior art, each ship must be provided with a gas evaporation plant.

The object of the invention is to remedy the disadvantages of the prior art.

The object is achieved in accordance with the invention, by the characteristics given in the description below and in the following claims.

A floating, preferably free-sailing coupling unit is connected to a receiving installation for gas via a pipe or hose connection. The coupling unit is provided with a propulsion machinery and is arranged to connect to a ship, preferably at the ship's loading manifold, in a manner that is known *per se*, e.g. by the use of hawsers, buoyancy, suction cups, magnets or similar.

The propulsion machinery of the coupling unit may be provided with sufficient pushing power to maintain a ship which is connected to an anchorage point, in the correct position. Use

of the ship's bow thrusters in addition to the coupling unit's propulsion machinery may be sufficient for the required positioning.

The coupling unit is arranged to connect to the ship's normal loading manifold and receive liquefied natural gas.

From the ship's ordinary loading manifold, the liquefied gas flows, preferably via gas pumps, to a submerged evaporator located on the coupling unit. After the gas has evaporated, it flows to the consuming point or an onshore gas distribution network via the pipeline.

The energy for evaporation of gas comes from seawater that is pumped through the evaporator.

If the temperature of the seawater at the unloading site is too low to be able to deliver the required energy to the evaporation process, energy may be supplied from the ship's steam boiler or another source of energy located on the ship, on the coupling unit or onshore.

The coupling unit is well suited for remote control and may with advantage be used unmanned.

As appears from the description above, the coupling unit may be used when loading ordinary ships by use of the ship's normal loading manifold, without requiring any conversions on the ship.

The following describes a non-limiting example of a preferred embodiment illustrated in the accompanying drawings, in which:

Figure 1 shows a coupling unit connected to a ship, the ship being moored to a buoy anchored to the seabed;

Figure 2 is an enlarged view of the coupling unit in the operative position, seen in the longitudinal direction of the ship;

Figure 3 is a side view of the coupling unit on the same scale; and

Figure 4 shows the same view as figure 2, without the ship, but here the coupling unit is positioned higher up in the sea.

In the drawings, reference number 1 denotes a coupling unit comprising a hull 2 and a propulsion machinery 4. The coupling unit 1 is provided with a connecting element 6 according to prior art as *per se* for tying up to a ship 8.

A hawser 10 ties the ship to a buoy 14 anchored to the seabed 12. A flexible tube connection 16 runs from the coupling unit 1 through the sea 18 and down to a pipeline 20 disposed on the seabed 12, which pipeline is connected to an onshore gas receiving installation (not shown).

During the unloading operation, the propulsion machinery 4 maintains tension in the hawser 10, whereby the ship is kept at a safe distance from the buoy 14. Thus the use of a

separate tugboat for positioning purposes during the unloading operation is not required.

One end portion of a pipe connection 22, see figure 2, is connected to the ship's 8 loading manifold (not shown), while the opposite end portion is connected to the receiving pipe 24 of the coupling unit 1, see figure 3. The receiving pipe 24 conducts the incoming liquefied gas to four gas pumps 26 arranged to increase the pressure of the incoming liquefied gas to a pressure which is appropriate for the subsequent evaporation and delivery.

From the gas pumps 26, the liquefied gas flows via high pressure gas pipes 28 to four submerged evaporators 30. In the evaporators 30, sufficient heat is added to the liquefied gas to allow it to gasify at the existing pressure.

Following the evaporation, the gas flows via a header 32, the flexible tube connection 16 and the pipeline 20 to the onshore gas receiving installation (not shown).

Seawater is pumped by seawater pumps 36 that are submerged when operative, via suction filters 38 and seawater pipes 40, through the evaporators 30 and corresponding outlet pipes 42, and back into the sea 18.

In the evaporators 40, the seawater will as a result of the temperature difference between the seawater and the liquefied gas, give off heat to the gas, causing the liquefied gas to evaporate.

In areas where the temperature of the seawater is not sufficient to provide the heat required by the gas, heating

of the gas may be achieved wholly or in part by using energy from another source, e.g. from the ship's (8) steam boiler (not shown) or another source of energy (not shown) onboard the coupling unit (1) or onshore.

C l a i m s

1. A method of regasifying LNG from a ship (8) in the open sea, where use is made of a coupling unit (1) arranged to be connected to the ship (8) at the ship's (8) loading manifold, and where the coupling unit (1) is provided with a regasification plant (30) and pipelines required for transporting the regasified LNG to a receiving installation, the coupling unit (1) receiving LNG from the ship via a pipe connection (22) and regasifying LNG by means of said regasification plant, then pumping the gas to the receiving site, c h a r a c t e r i z e d i n that the coupling unit (1) manoeuvres itself to the ship (8) during the connection operation to and disconnection operation from the ship (8), by means of its own propulsion machinery (4).

2. A method according to Claim 1, c h a r a c t e r - i z e d i n that the coupling unit keeps the ship in the desired position during the unloading operation by means of its propulsion machinery (4).

3. A device for regasification of LNG from a ship (8) in the open sea, where use is made of a coupling unit (1) arranged to be connected to the ship (8) at the ship's (8) loading manifold, wherein the coupling device (1) is provided with a regasification plant (30) and pipelines required for transporting the regasified LNG to a receiving installation, the coupling unit (1) receiving LNG from the ship via a pipe connection (22) and regasifying LNG by means of said regasification plant and pumping the gas to the receiving site, c h a -

r a c t e r i z e d i n that the coupling unit (1) is free-floating and arranged to manoeuvre itself to the ship (8) during the connection to and disconnection from the ship (8), by means of its own propulsion machinery (4).

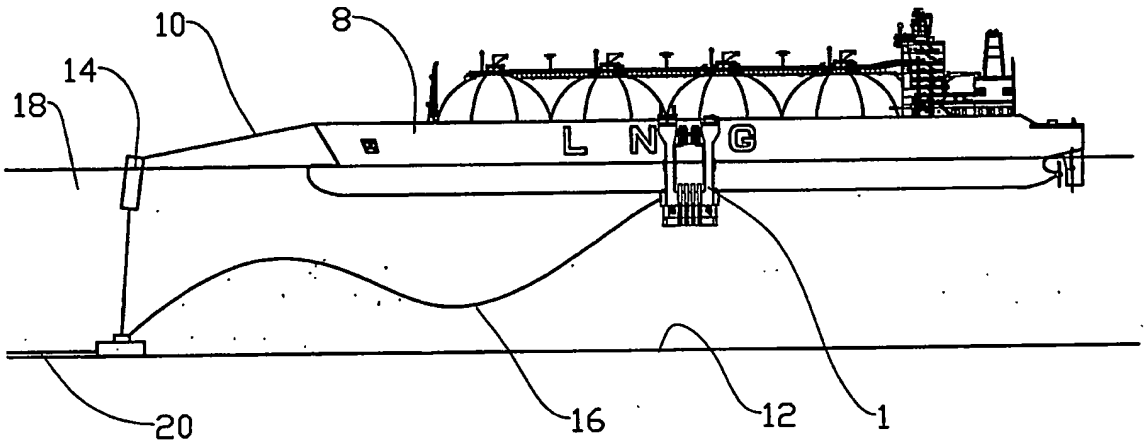

Fig. 1

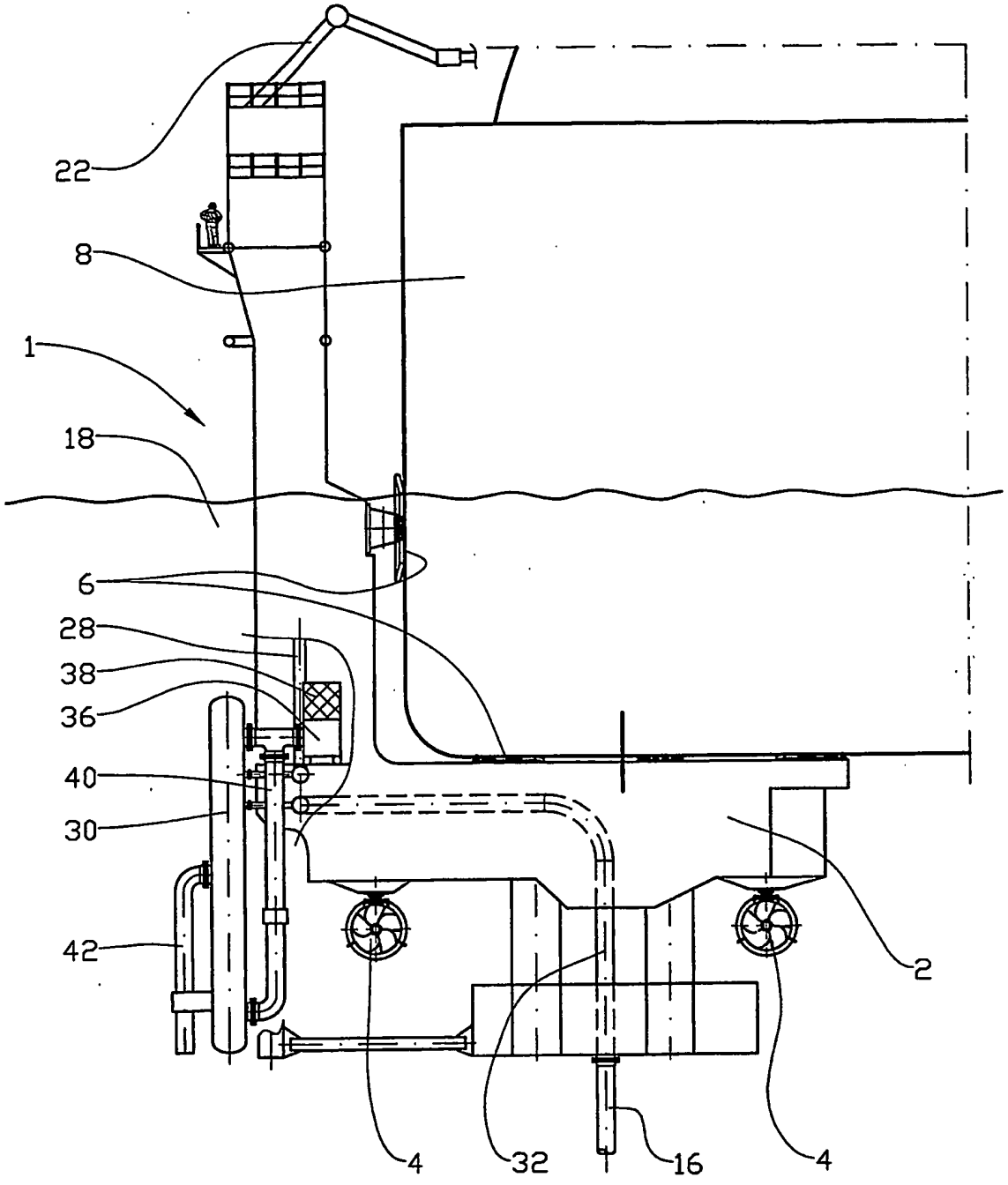

Fig. 2

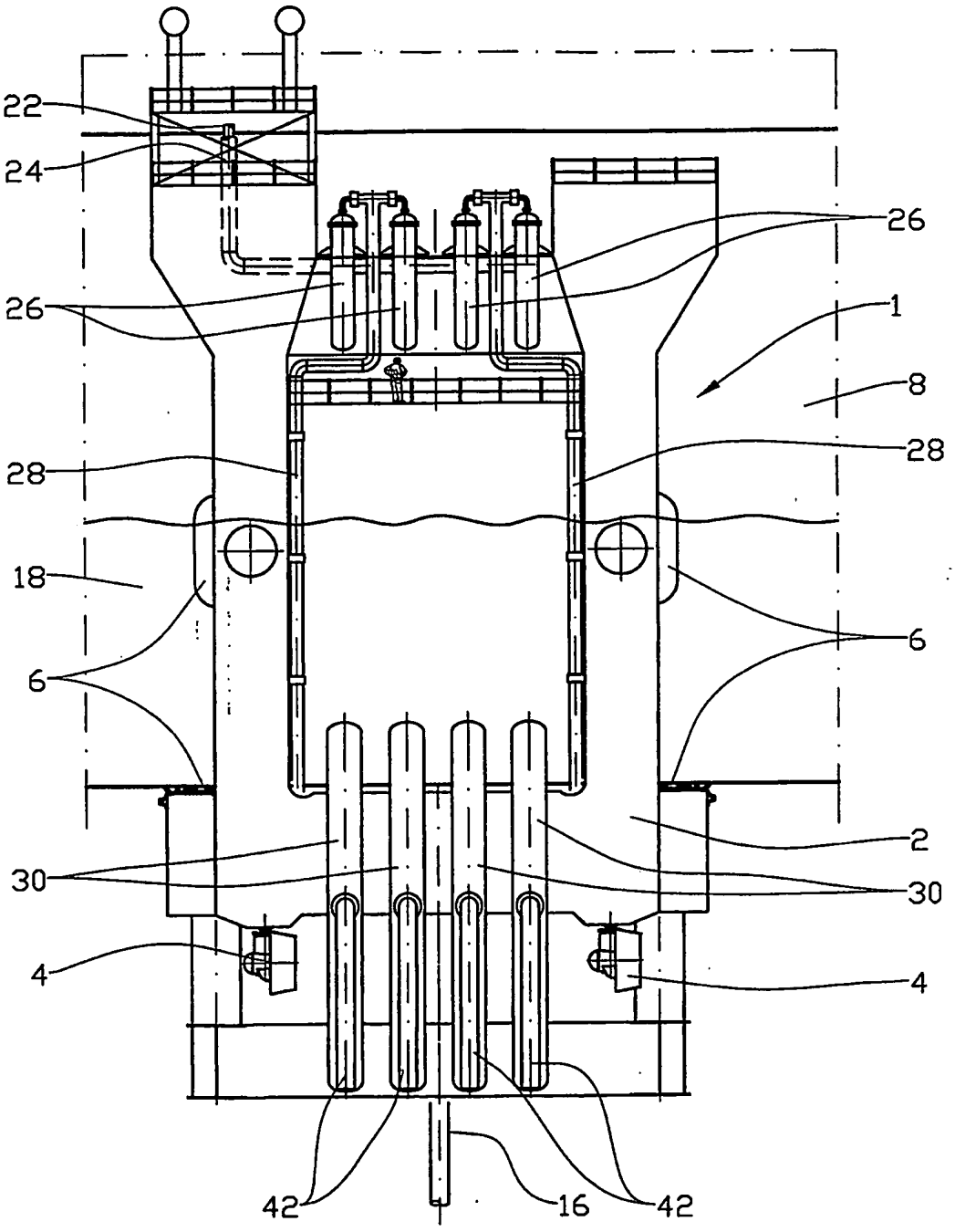

Fig. 3

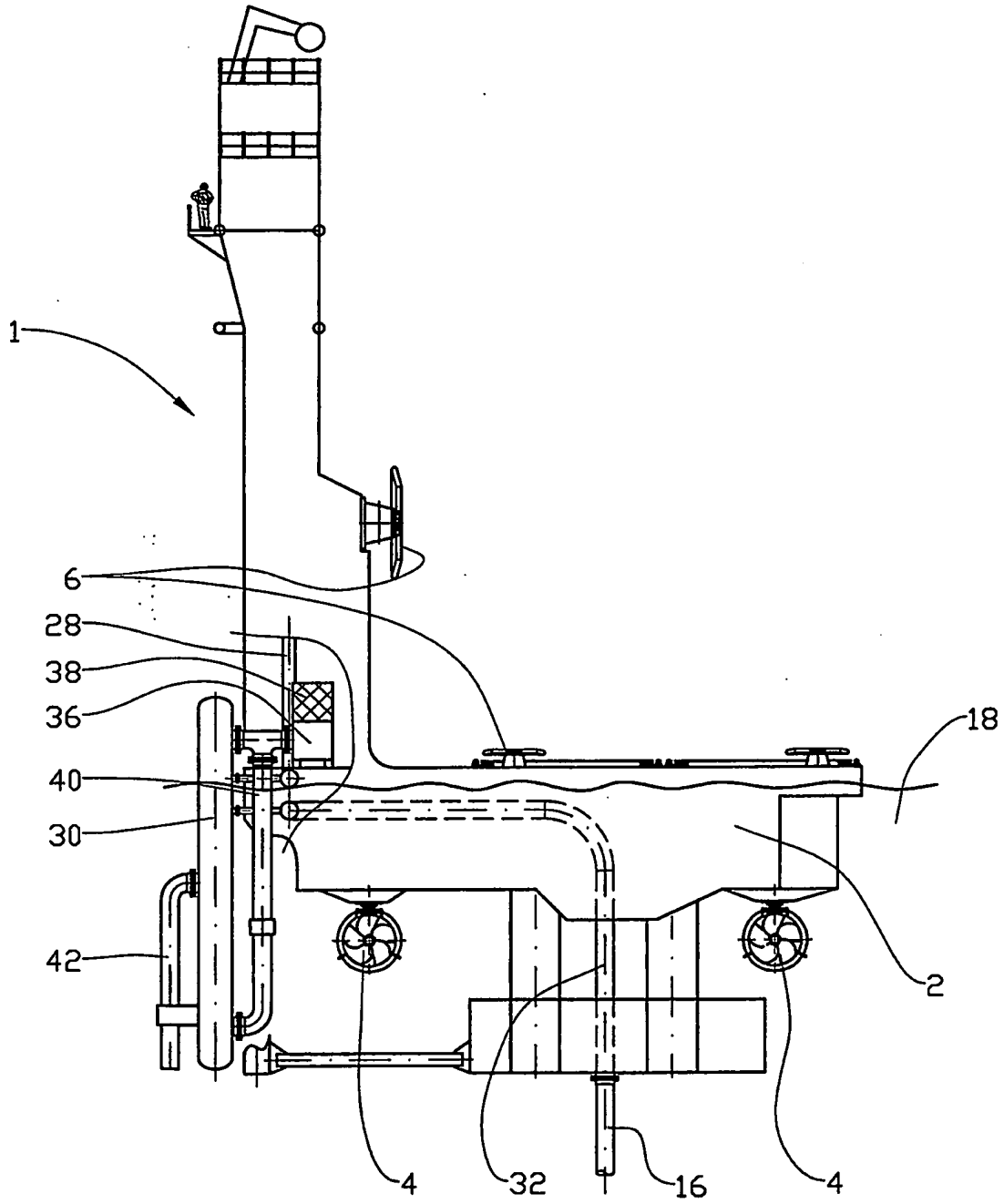

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 2004/000120

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F17C 9/02, B63B 27/24
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F17C, B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002073619 A1 (W. PERKINS ET AL), 20 June 2002 (20.06.2002), figure 1, abstract --	1-3
X	US 2002174662 A1 (F.C. FRIMM ET AL), 28 November 2002 (28.11.2002), paragraph (0013), figures 3,4, abstract --	1-3
A	US 3969781 A (W.R. REID, JR.), 20 July 1976 (20.07.1976), whole document --	1-3
A	WO 0103793 A1 (MOSS MARITIME A.S.), 18 January 2001 (18.01.2001), whole document --	1-3

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 August 2004	06 -08- 2004
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Anna Salomonsson / MRo Telephone No. +46 8 782 25 00

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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6089022 A (J.J. ZEDNIK ET AL), 18 July 2000 (18.07.2000), whole document -- --------	1-3

US	2002073619	A1	20/06/2002	NONE		
US	2002174662	A1	28/11/2002	US	6546739 B	15/04/2003
				WO	02095284 A	28/11/2002
US	3969781	A	20/07/1976	AU	469352 B	12/02/1976
				AU	7366274 A	12/02/1976
				BR	7407140 D	00/00/0000
				CA	999615 A	09/11/1976
				FR	2242291 A,B	28/03/1975
				GB	1484693 A	01/09/1977
				IT	1020200 B	20/12/1977
				JP	951115 C	27/04/1979
				JP	50076779 A	23/06/1975
				JP	53030437 B	26/08/1978
				NL	7411201 A	03/03/1975
				NO	142897 B,C	04/08/1980
				NO	743044 A	24/03/1975
WO	0103793	A1	18/01/2001	AU	7459800 A	30/01/2001
				JP	2003517545 T	27/05/2003
				NO	308714 B	16/10/2000
				NO	993389 D	00/00/0000
				US	6578366 B	17/06/2003
US	6089022	A	18/07/2000	AU	3187799 A	11/10/1999
				BR	9908898 A	21/11/2000
				CN	1109230 B	21/05/2003
				CN	1293747 T	02/05/2001
				EP	1064506 A	03/01/2001
				JP	2002506960 T	05/03/2002
				US	5935853 A	10/08/1999
				WO	9947869 A	23/09/1999